Egypt. Poult. Sci. Vol. (43) (I): (1-18) (2023) **(2107-1174)**

Egyptian Poultry Science Journal

http://www.epsj.journals.ekb.eg/

ISSN: 1110-5623 (Print) – 2090-0570 (Online)

PRODUCTIVE AND REPRODUCTIVE PERFORMANCE CHARACTERIZATION OF PHENOTYPES IN EGYPTIAN GEESE (*ANSER ANSER*)

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Received: 30/12/2022 Accepted: 29 /01/2023

ABSTRAC: Studying the phenotypic characteristics for Egyptian geese resulted to them having three phenotypes, Fayoumy, Saiddy, and Behary, which were reared in the Med, Upper, and Delta regions of Egypt, respectively. The goal of this study is to describe the production and reproduction characteristics of three Egyptian geese (*Anser anser*) in order to shed light on the economic aspects for defining strategic goals to preserve the required variety and long-term usage. Also, characterization the production and reproduction features may be part to answer to a question about probability the Egyptian Geese is one population or more. Each phenotype of the bird was housed separately. Fayoumy, Saiddy, and Behary phenotypes were used to evaluate egg quality, fertility, hatching, and growth performance. There is no significant difference ($P < 0.05$) between phenotypes in daily feed intake, daily body growth, and feed conversions. The greatest value in body weights in adult females was in the Fayoumy phenotype. The Behary phenotype had the lowest fertility and hatching rates. The Fayoumy phenotype was having the highest values in Egg weight and gosling weight at hatching. The present study characterized the production and reproduction features that showed slightly different among the phenotypes. We may infer that both the Fayoumy and Behary phenotypes have relatively a high daily feed intake and daily body gain. The Saiddy phenotype may be especially appealing in its fertility and hatching rates. More research on performance characterization in Egyptian geese phenotypes is required to evaluate their economic performance.

Keywords: Productive traits; Reproductive traits; Egg quality; Phenotypes; Egyptian geese.

INTRODUCTION

The goose was one of the earliest birds to be domesticated in Egypt around 3000 years ago (Houlihan, 1997). Around 2686–2181 BC, the Ancient Egyptians developed a force-feeding method for producing fatty liver and introduced the feather plucking technique for geese (Romanov, 1997 and Wilson *et al*., 2019). Drawings of geese on the walls of ancient Egyptian temples revealed Egypt's two species of farmed geese (Abdel-Kafy *et al*., 2021). The first was the Egyptian goose (*Alopochen aegyptiaca*), a wild species of the Tadorninae subfamily (Scherf, 2000). The second variety is descended from the greylag goose (*Anser anser*) (Koch, 2014), which was a massive goose breed in ancient Egypt from 600 BC to 200 AD (Romanov 2011 and Boessneck, 1991). As a result of their tolerance to comprehensive husbandry, disease resistance, and meat quality, geese are vital Egyptian national genetic resources. Regional and global operations have benefited in recent years from a focus on the long-term development of animal genetic resources. According FAO guidelines, a descriptive pattern is required for characterization of the phenotypic, genetic, production and reproduction features of animal genetic resources (AnGR). By 2016, the phonotypic features of Egyptian geese had been studied in villages throughout the Nile Valley, which could be divided into three primary regions: Upper, Middle, and Delta Egypt (Abdel-Kafy et al., 2016). The phonotypic features studied by measuring morphological measurements in some body parts included the head, chest and legs of the geese. This research revealed to the Egyptian geese was three phenotypes: Fayoumy, Saiddy, and Behary, that are often bred in the Upper, Middle, and Delta Egypt areas, respectively. In addition, a study conducted in Upper (Luxor), Middle (Fayoum), and Delta (Kafr El-Sheikh) Egypt to characterize the genetics of these phenotypes revealed a high inbreeding level and low genetic differentiation based on mitochondrial D-loop and micro-satellite markers (Abdel-Kafy *et al*., 2021). To complete the characterization of the Egyptian geese (*Anser anser*), it is necessary to characterize their production features in order to gather data in accordance with the FAO's AnGR criteria (FAO, 2012). The phonotypes of Egyptian gooses (*Anser anser*) are encountering technological and logistical hurdles in their production. This could be because domestic Egyptian geese production is primarily based on small flocks reared by smallholder farmers in villages around the Nile Valley, which can be divided into three major regions, namely the Upper, Middle, and Delta Egypt regions, and there are currently no intensive or commercial geese farms in Egypt (Makram *et al*., 2018). In addition, there is minimal information on productive and reproductive performance traits in Egyptian geese. They investigated the effects of various experimental conditions on performance traits such as sex (El-Hammady *et al*., 2007), different managerial systems(El-Hanoun *et al*., 2012), dietary protein levels (Abou-Kassem *et al*., 2019), dietary protein levels and sulfur-containing amino acids (Ashour et al., 2020), and dietary crude protein and metabolizable energy levels (Alagawany *et al*., 2020). However, these studies did not focus on goose phenotypes, and hence their productive and reproductive performance traits were not described. It is known that local breeds are characterized by high resistance, and are adapted to local agricultural climatic conditions and to maintain local geese breeds. Thus, flocks of Fayoumy, Saiddy, and Behary phenotypes were formed as a core with a wide genetic variety. As a result, the goal of this study is to describe the production and reproduction characteristics of three Egyptian geese (*Anser anser*) in order to shed light on the economic aspects for defining strategic goals to preserve the required variety and long-term usage. Also, characterization the production features reproduction features may be part to answer to a question about probability the Egyptian Geese is one population or more.

MATERIAL AND METHODS

2-1- Study location and Ethics:

In 2016, flocks of Fayoumy, Saiddy, and Behary geese were established by transferring geese from villages in Fayoum, Luxor, and Kafr-Elsheikh governorates, respectively, into El-Serw water fowls Research Station belongs to APRI, the Agricultural Research Center (ARC). Damietta governorate, northwestern region of Egypt, Located in Latitude 31.2431 Longitude 31.7961. The Institute's animal research ethical guidelines were followed, and the Institute's Research Committee approved the study plan in December 2017 (Code no. 203429).

2-2- Bird management:

Flocks from the Fayoumy, Saiddy, and Behary phenotypes had 30, 34, and 28 females, with 10, 12, and 9 ganders, respectively. Each phenotype bird was housed separately inwards as 2.5 birds/m^2 in an open system with windows and given out yard as free range area with density of birds was 1 geese/m2from 08:00 to 17:00 if the weather conditions were favorable. In the out yard there is concrete swimming pool supplied with clean and fresh water. Fresh water and mash feed was provided ad-labium. Feeders provided sufficient feeding space. The diets were formulated from plant origin. The NRC's breeder diets were designed to suit the nutritional needs of growing and breeding geese. Natural daylight, which entered the house through the windows, was supplemented with artificial lighting (incandescent lamps) for 16 hours of light and 8 hours of darkness per day. The environmental conditions was natural for the season with temperature degree ranged (18.2 to 39.5^{o}C) while proportional humidity ranged (63.7 to 78.1 %). Wheat straw with depth of about 8-10 cm was used as a litter. It being replaced the wet or caked litter with fresh and dry litter material.

The breeders were maintained under similar managerial, hygienic and vaccine programs. During the breeding season, which lasted from November to May, ganders and females naturally met. The breeders were maintained under the same administrative, sanitary, and environmental settings.

2-3- Egg quality measurements:

According to Attia *et al*. (1994), 40 eggs per phenotype were collected and randomly dispersed into five replicates (8 eggs per replicate) to test egg quality traits. The eggs were individually weighed to the closest 0.01g using an electronic scale, and the length and width of the eggs were measured using a caliper to determine the shape index using formula of Anderson, 2004: Shape index = (egg width (mm) / egg length (mm)* 100. The eggs were then cracked on the table with a flat glass; the diameter of the yolk was measured with a caliper, and the height of the yolk and albumen was measured with a three-legged micrometer. After cleaning, the shell thickness was measured using a micrometer in three separate locations (sharp, blunt, and equatorial). The egg yolk index (YI) was calculated using the formula Yolk Index = Average height of yolk (mm)/Average diameter of yolk (mm), as stated by Funk, 1948 and Eke *et al.*, 2013. The Haugh unit (HU) was determined according to the following formulation: HU = 100 log (H-1.7W$^{0.37}$ + 7.57) (3) Where H was the height of the thick albumen in mm and W was the weight of the egg in g, which was first described by Haugh, 1937.

2-4- Hatching traits:

Hatching traits were assessed by collecting hatching eggs for seven days in nine hatches, with three replicates for each phenotype. The eggs were collected and preserved in a cold-humid area with the small end pointed downward. They were numbered and individual weighed to the nearest 0.01 g.

Eggs were set in the automatic 'Econom' incubator (Netherland - made) which electronically controlled for temperature and relative humidity. It's were incubated horizontally and turned every 1 h until they transferred to the hatching compartment.

The temperatures and relative humidity were 37.3^{o}C and 63 % RH during the incubation period (1-24 days). Candling was performed at the 10th day of incubation to count and cull the infertile egg and early embryonic mortality.

The eggs from 14th to 24th days of incubation period were moved out of the incubator for cooling at 28-30^{o}C twice per day for 20 minutes and then sprayed with warmed water at 37.3 °C and placed back again**.**

At the 25th day of incubation, the eggs were transported to the hatching chamber at 36.8^{o}C and 78% RH during the hatching period (25-28 days).

At the end of the incubation period, the healthy hatched goslings and late embryonic mortality (un-hatched eggs with live or dead embryos and dead hatched goslings) were counted. Then, hatchability and embryonic mortality percentages were calculated. Fumigation of incubator was done carefully after every successful operation. Also, hatched goslings were weighed.

2-5- Growth performance traits:

At hatch, each phenotype's healthy goslings were individually weighed and randomly distributed into three replicates (each with 20 goslings), which were brooded in properly ventilated pens. During the first week, the brooder temperature was 33 °C, and then steadily fell by 2-3 °C per week until it reached 28 °C, with light being 24 hours per day for the first three days of housing, then reduced to a continuous 21 hours daily for the remainder of the term. As a litter, dry wheat chaff was utilized. All of the goslings were raised under the same hygienic and management settings. Throughout the study period, diets and fresh water were provided at all times. The NRC, 1994 developed diets intended to meet the nutritional needs of growing geese. For the first three weeks of life, the goslings were fed a starter diet containing

20% crude protein and 2900 kcal ME/kg, followed by a grower diet containing 15% crude protein and 3000 kcal ME/kg from three to nine weeks of age, and a finisher diet containing 16% crude protein and 2900 kcal ME/kg diet from nine to sixteen weeks of age. From hatching to 12 weeks of age, each replicate of each phenotype had its live body weight, body weight gain, feed intake, and feed conversion rate (FCR) (g. feed intake /g. body weight gain) recorded biweekly.

2-6- Statistical analysis:

The PROC GLM procedure in SAS 9.3 Statistical Analysis Software was used to estimate the least squares means and standard errors for the characteristics in each phenotype at various ages (www.sas.com). One-way analysis of variance (ANOVA) was performed to determine the effects of phenotypes on studied traits with using model: $Y_{ij}= \mu + P_i + T_j+ e_{ij}$; where: μ= the overall mean of the population of the variable; P_i = the effect of phenotypes, T_j= repetition effect; e_{ij} = the random error**.** The traditional F test was used to comparing effects the fixed factors and significance was declared at $P \leq 0.05$. Duncan's multiple range test procedure in SAS was used to compare differences between means of phenotypes at 5% level of significance.

RESULTS

3-1- Productive traits:

Table 1 depicts the influence of phenotypes on body weight (BW). There were substantial differences in body weights across phenotypes at different experimental periods (P < 0.05), particularly at marketing age. Fayoumy phenotype geese had the highest BW, while Behary phenotype geese had the lowest.

Table 2 shows the influence of phenotypes on daily feed intake (g). There were no significant changes in daily feed intake (DFI) across phenotypes over different experimental periods (P < 0.05), but DFI was considerably different (P < 0.05) from hatching to 12 weeks. The Fayoumy phenotype had the highest DFI value, while the Saiddy genotype had the lowest.

Figure 1 shows that the daily body gain (DBG) values of different geese phenotypes did not vary significantly. The DBG levels were similar across diverse bird phenotypes. In both Fayoumy and Saiddy, the trend of DBG values increased from hatching age to 8 weeks, then declined from 8 to 10 weeks, and then returned to rise from 10 to 12 weeks in both Fayoumy and Saiddy. However, the Behairy continued to decrease from 10 to 12 weeks. Different phenotypes of birds did not have significantly different periods from hatching to 12 weeks of age (P > 0.05) (Figure 2).

There were no significant variations in feed conversions (FC) across phenotypes over various times (Figure 3), from hatching to 12 weeks age (Figure 4).

3-2- Reproduction traits:

The body weights of mature goose females substantially varied (P < 0.05) across various phenotypes of birds (Figure 5), with the Fayoumy phenotype having the highest average of mature body weights. The number of eggs was not statistically different, but the weight (g) and mass (g) of the eggs were significantly different (Table 3). Phenotypes impacted gosling weight (g) at hatching considerably (P < 0.05), although there was no significant difference in relative gosling weight to egg weight (Table 3). Table 3 shows that the percentages of fertility and hatchability were considerably different ($P < 0.05$). The Saiddy phenotype had greater fertility and hatchability rates than the other phenotypes, while the Behary phenotype had the lowest fertility and hatchability rates. The phenotypic effect has a considerable impact on total embryo mortality (TEM) percent in Egyptian geese phenotypes (Table 3). The lowest TEM percent value was found in the Saiddy phenotype, while the greatest TEM percent values were found in both Behairy and Fayoumy. The phenotypic effect; however, had no significant impact on EEM percent, LEM percent, or PbM percent.

3-3- Egg quality:

Table 4 shows the quality traits of eggs in Egyptian goose phenotypes. Physical external egg traits did not vary significantly when phenotypes were considered (Table 4). Only the albumen height in the internal features of the eggs differed considerably, while the other traits were unaffected by the phenotypic impact (Table 4).

3-4- Principal component analysis:

Figure 6 showed plot of principal component analysis (PCA) and first of the two PCs (PC1) were accounted 70.1, 73.3, and 59.4 percent of the total variation (Figure 6) in productive traits, reproductive traits, and egg quality assessments, respectively. Principal component 2 (PC2) on the y-axis explained 27, 15.2 and 16.9% of the variation in the data.

DISCUSSION

From hatching to 12 weeks of age, the body weight (BW) of the goose phenotypes exhibited a clear and steady rise with age. This is an expected outcome, and it agrees with Wang *et al.* 2002, who found that the maximum BW was reached during sexual maturity. At 2, 4, and 6 weeks of age, the BW values for male and female geese in the study by El-Hanoun *et al.* 2012 were (458.4 and 425.5 g), (934.9 and 883.3 g), and (1460.2 and 1382.0 g), respectively. At 12 weeks, the body weights in this study were similar to those of Ashour *et al.*, 2020 (3102 - 3090g) and Abou-Kassem *et al.*, 2019 (3187-3009g), but were somewhat lower than those of Alagawany *et al.*, 2020 (3618-3466g). When comparing the body weights of our local phenotypes at 8 weeks of age, the average was 2185 g, which was much less than the weights of pilgrims (3.42 kg), Hungarians (3.09 kg), Chinese (3.31 kg), and Landaise geese (4.5 kg, INRA 07) (Guy *et al*., 1997). Following that, at 10 weeks of age, the average BW for all phenotypes was 2608.3 g, which was lower than the weights of Bohemian geese, which varied from 4.58 to 3.9 kg (Hrouz, 1988). The daily body weight gain (BWG) average of goose phenotypes followed the same pattern as the body weight measures, as predicted. Furthermore, the data revealed that BWG averages grew significantly from 6 to 8 weeks of age, with an average of 49.3 g. Following that, the daily BWG significantly decreased throughout the 8-10 week period, which averaged 30.2 g. A similar pattern was previously documented, with the highest increases in daily BWG being 40.6 and 54.5 g during the fifth and sixth weeks of life, respectively (El-Hammady *et al*., 2007). Hungan *et al*.,2005 discovered that the daily averages of BWG of Magang geese were 38.3 and 43.5 grams at 2-3 and 6-7 weeks of age, respectively, which were comparable to the values obtained in the current research (36.1 and 49.3 g) during 2-4 and 6-8 weeks. The daily BWG in the current research was lower (34.6–31.6 versus 41.1-39.2 and 48.40–48.06 g) than those reported by Alagawany *et al*., 2020 and Abou-Kassem *et al*., 2019 during 1–12 weeks. Feed intake in Egyptian phenotypes was extremely similar to El-Hammady *et al*., 2007 (167.0-147 vs. 159.8-150.8 g/bird/d) results. The findings revealed that the daily average feed consumption steadily increased with age. During the fifth and seventh weeks of life, the daily average FI of Magang geese was 108 and 176 g, respectively (Hungan *et al*., 2005). Although there were substantial ($P < 0.01$) changes in daily body gain in Egyptian goose phenotypes from hatching to 12 weeks of age, there were no significant changes in the feed conversion rate (FCR). The Fayoumy phenotype had the highest body weight and FCR of all of the phenotypes. The feed conversion rate in the current research was 4.54-4.82, which was higher than 3.26 - 3.28 (Ashour *et al*., 2020) and 3.01- 3.08 (El-Hanoun *et al*. 2012). El-Hanoun *et al*. 2012 found that FCR by g feed/g gain ranged from 7.0 to 5.1 between 4 and 20 weeks. In all phenotypes, feed consumption efficiency dropped slightly with age, up to 12 weeks of age. The mean FC values in the current research were similar to those reported by El-Hammady *et al*., 2007 in mixed M and F local geese, which were 3.3, 3.7, 4.3, and 4.8 at 2 and up to 7, 11, and 15 weeks of age, respectively. FCR values were compared in Magang geese at the third (2.13 kg) and seventh (4.05 kg) weeks (Hungan *et al*., 2005). The efficiency of feed consumption and growth traits in geese are affected by a variety of factors, including phenotype, sex, age, and diet (Biesek *et al*., 2020).

The fertility value (75.0-88.1%) is comparable to the values published by El-Hanoun *et al*.2012, which were 84.2-77.5%, while the hatchability of viable eggs was 88.6-82.8%. According to Önk and Kirmizibayrak, 2019, the fertility percentage varies between goose breeds, ranging from 53.8 to 84.72%. Significant differences in fertility may be attributed to genetics (Salamon and Kent, 2016), and it is dependent on the female's capacity to ovulate, retain sperm, which is essential for fertility, and create an environment for fertilization and egg production (Bogenfurst, 2017). As revealed by Bogenfurst, 2017, the fertility and hatchability exhibited minimal heterogeneity across phenotypes, which may be attributable to the variation of body weight, while heavier breeds have significantly reduced reproducing potential (e.g. fertility, hatchability, egg production). Current research classified mortality during incubation into two key phases in avian species with mortality peaks: early embryonic life and just before hatching (Kuurman et al 2003). The development of the blood circulatory system, as well as the shift in food from simple carbohydrates to more complex proteins and fats, all correlate with early embryonic mortality (Salamon, 2020). Different EEM percentages across phenotypes may be linked to inadequate nutrition availability in the egg or the egg being exposed to improper settings that did not fit the demands of the growing embryo (Christensen, 2001) and the effect of genetic defects (Liptói and Hidas 2006). Different phenotypes may have a higher or lower percentage of later embryo mortality (LEM). The egg weight

(g) and shell thickness values in this investigation were lower than the results (147 – 155 g and 0.36 – 0.44 mm, respectively). El-Hanoun *et al*.,2012 found that the shape index values were close, ranging from 67.0 to 66.6%. The egg's external and internal features influence embryo growth and hatchability (Hegab and Hanafy ,2019). The albumen-yolk indices are essential characteristics that may impact hatchability (Tilki and Inal, 2004). This might be explained by the variation in hatchability among the phenotypes that differed considerably in albumen height and Haugh Unit (HU). In the current investigation, we observed a high gosling weight hatching from a heavy egg weight. In native Turkish geese, there was a substantial positive connection (72%) between egg weight and hatching weight ($P < 0.01$) (Saatci *et al*., 2005). Furthermore, the regression equation revealed that for every one g increase in egg weight, hatching weight increased by 0.51 g (Saatci *et al*., 2005). A positive correlation between egg weight and hatching weight was observed for Japanese quail (Santos *et al*., 2015) for ducks (Weis *et al*., 2011) and geese (Shanawany 1987).

Principal component analysis (PCA) is a mathematical approach that applies an orthogonal transformation to reduce phenotypic information to a smaller number of orthogonal latent variables with little information loss. To offer knowledge of the relationships between the examined traits, the multidimensional distribution of phenotypic values of traits might be reduced (Savegnago *et al*., 2011). The cluster analysis approach is often used to summarize data into a number of groups based on homogeneity and heterogeneity across groupings (Ventura *et al*., 2012). The principal component analysis (PCA) plot (Figure 6) for the productive characteristics, reproductive traits, and egg quality measures revealed substantial to moderate overlaps, suggesting that the observed factors differed only slightly across the three phenotypes. The highest PC1 values were found in the reproductive characteristics of the three phenotypes. Also , reproductive characteristics the overlaps between Behairy and Fayoumy was highly while Saiddy phenotype the overlap was moderate with Behairy and Fayoumy that indicate that there is a difference in the measured variables in reproductive characteristics data. This may be due to Saiddy phenotype has smaller eggs that are easier to incubate and hatching performance is higher.

The present study characterized the production and reproduction features that showed slightly different among the phenotypes. The previously researches were to study the genetic and phenotypic characterization of the Egyptian phenotypes. The genetics characterization of these phenotypes revealed low genetic differentiation (Abdel-Kafy *et al*., 2021) while the morphological characterization research revealed to the Egyptian geese were three phenotypes; Fayoumy, Saiddy, and Behary (Abdel-Kafy *et al*., 2016). When these phenotypes folks were adjacent in the farm, these morphological measurements were invisible to the naked eye. Based on the preliminary results of the genetics, production and morphological characterization in the Egyptian phenotypes, they may be as one population.

CONCLUSIONS

This is the first study to shed light on the productive and reproductive performance characteristics of Egyptian goose phenotypes. The measured variables in Behairy, Fayoumy and Saiddy phenotype reproductive characteristics were slightly differed. We may infer that both the Fayoumy and Behary phenotypes have relatively high meat performance, as well as a high daily feed intake and daily body gain. The Saiddy phenotype may be having especially advantageous in the fertility and hatching. More research on performance characterization in Egyptian goose phenotypes is needed to improve their economic performance attributes for long-term use.

List of abbreviations:

NRC= National Research Council
YI= Yolk index
HU = Haugh unit
H = the height of the thick albumen
W = the weight of the egg
Kcal = kilocalories
ME= Metabolizable Energy
Kg= kilogram
ANOVA = Analysis of variance
DFI = Daily feed intake
DBG= Daily body gain
FC= Feed conversions
PCA= Principal component analysis
BW =body weight
M = Male and F=Female

Authors' contributions

All authors have read and approved the manuscript.

The individual Authors' contributions are as following: Conceptualization E.M.A. and H.A.S.; Methodology, W.A.H.A. and M.A.M.A.; Software, S.E.I. and A.E; Formal analysis, S.M.E.Z. and W.A.H.A.; Investigation, A.E and S.E.I.; Data curation, M.A.L.G., S.M.E.Z.; Writing W.A.H.A; Supervision, H.A.S.; Project administration, E.M.A.

Funding:

This study was conducted on Fayoumy, Saiddy, and Behary phenotype flocks that were raised as part of the project "Conservation and estimation of the genetic diversity and structure of the Egyptian goose population," which was funded by Egypt's Science and Technology Development Fund (STDF) under code number 15260.

ACKNOWLEDGMENTS

The authors are grateful to the staffs of El-Serw Farm in Damietta governorate belongs Animal Production Research Institute (APRI) for their assistance in preserving the phenotypic flocks and conducting this study.

CONFLICTS OF INTEREST:

The authors declare no conflict of interest. The funders had no role in the design of the study; in the collection, analysis, or interpretation of data; in the writing of the manuscript; or in the decision to publish the results.

Table (1): Means of body weight (g) as a function of phenotypes in Egyptian geese of various ages.

Body weight (g) at :	**Fayoumy**	**Behary**	**Saiddy**	**SEM**
Hatching	96.0^{a}	81.3^{b}	82.6^{b}	3.0
2 Weeks	415.0	381.6	360.0	24.6
4 Weeks	953.3^{a}	890.0^{ab}	825.0^{b}	29.9
6 Weeks	1556.6^{a}	1521.6^{ab}	1406.6^{b}	40.7
8 Weeks	2283.3	2188.3	2085.0	69.8
10 Weeks	2755.0^{a}	2633.3^{ab}	2436.6^{b}	73.9
12 Weeks	3340.0^{a}	3016.6^{b}	3081.6^{ab}	79.7

$^{a\ and\ b}$ Means in the same row with different superscripts are significantly different at $P<0.05$.

Table (2): Means of daily feed intake (g) in Egyptian geese phenotypes from hatching to 12 weeks of age.

Daily Feed intake (DFI, g) in period:	**Fayoumy**	**Behary**	**Saiddy**	**SEM**
DFI Hatching -2Weeks	48.6	47.6	44.6	2.64
DFI 2- 4 Weeks	109.6	107.0	87.6	8.05
DFI 4 - 6Weeks	173.6	181.3	162.6	13.61
DFI 6 - 8 Weeks	260.3	244.6	224.6	18.18
DFI 8 - 10Weeks	218.6	216.3	169.0	43.02
DFI 10 -12Weeks	300.3	220.0	282.3	44.48
DFI Hatching - 12Weeks	167.0^{a}	151.6^{ab}	147.0^{b}	4.91

$^{a\ and\ b}$ Means in the same row with different superscripts are significantly different at *P*<0.05.

Table (3): Means of reproductive characteristics in Egyptian goose phenotypes.

Item	**Fayoumy**	**Behary**	**Saiddy**	**SEM**
Egg number (eggs/geese per year)	36.3	41.1	34.6	2.21
Egg Weight(g)	149.6^{a}	140.1^{a}	121.4^{b}	4.15
Egg mass (g)	5430.5^{a}	5758.1^{a}	4204.4^{b}	308.0
Fertility %	84.0^{a}	75.0^{b}	88.1^{a}	1.47
Hatchability %	53.2^{b}	49.5^{b}	63.9^{a}	2.84
Gosling weight(g) at hatching	94.9^{a}	82.1^{b}	81.7^{b}	2.66
Relative goslings weight %	67.4	59.2	67.0	3.61
Embryo Mortality traits:				
Total Embryo Mortality (TEM)%	46.7^{a}	50.4^{a}	36.0^{b}	2.84
Earl Embryo Mortality (EEM)%	15.9	21.1	17.6	1.90
Later Embryo Mortality (LEM)%	15.3	16.3	7.1	2.58
Pepped but non Hatching (PbH)%	15.5	13.0	11.3	2.06

$^{a\ and\ b}$ Means in the same row with different superscripts are significantly different at *P*<0.05

Table (4): Mean of egg quality in Egyptian geese phenotypes.

Item	Fayoumy	Behary	Saiddy	SEM
External characteristics of the egg:				
Egg Length(cm)	8.4	8.1	7.8	0.19
Egg Width (cm)	5.6	5.5	5.4	0.10
Shape index (%)	67.1	68.2	69.1	0.97
Internal characteristics of the eggs:				
Albumen height (mm)	7.5[b]	9.7[a]	8.8[a]	0.40
Yolk height (mm)	21.7	21.8	21.2	0.50
Yolk width (mm)	6.5	6.1	6.0	0.15
Shell Thick (mm)	0.34	0.35	0.34	0.013
Yolk index	3.3 [b]	3.52 [a]	3.50 [a]	0.028
Haugh Unit (HU)	4.28 [b]	6.76 [a]	6.34 [a]	0.33

[a and b] Means in the same row with different superscripts are significantly different at $P<0.05$.

Figure (1): Mean daily body gain (DBG) in Egyptian geese phenotypes during different time periods.

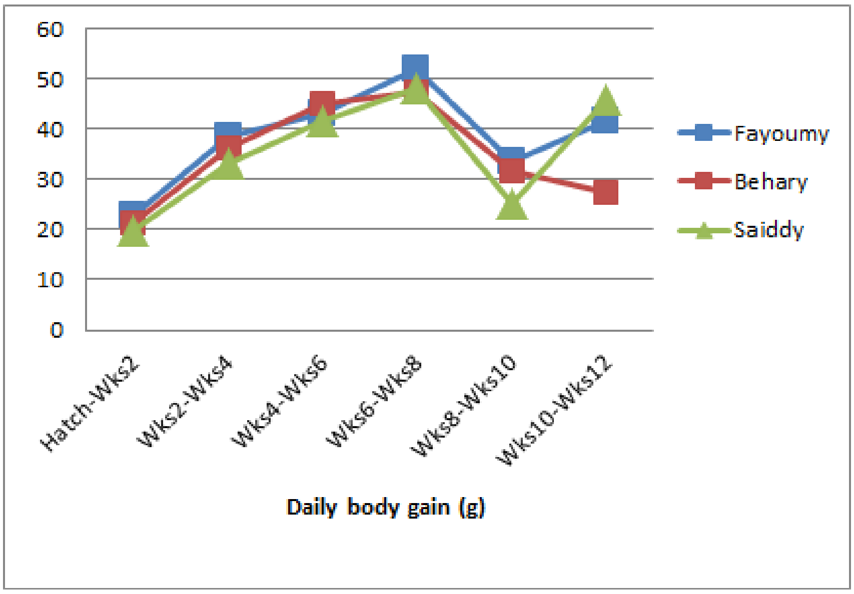


Figure (2): Mean daily body weight gain in Egyptian geese phenotypes from hatching to 12 weeks of age.

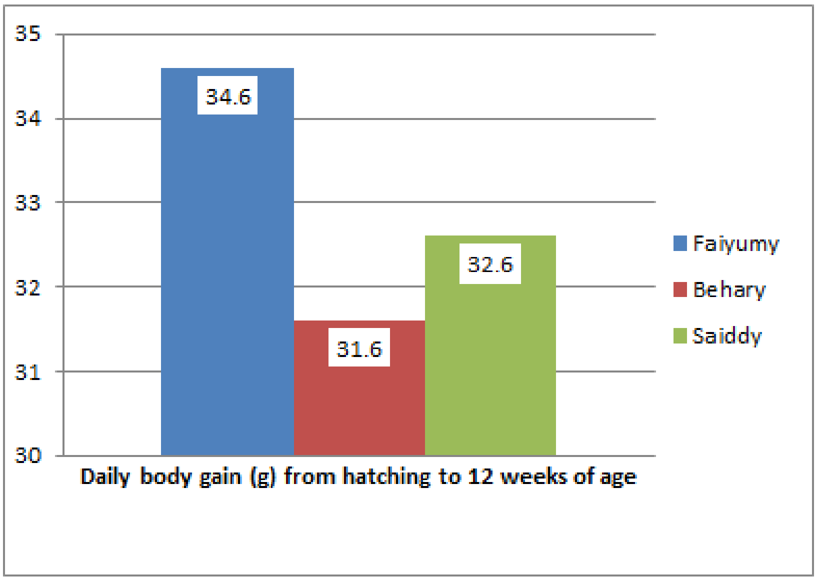


Figure (3): Mean feed conversions in Egyptian geese phenotypes over various periods from hatching to 12 weeks of age.

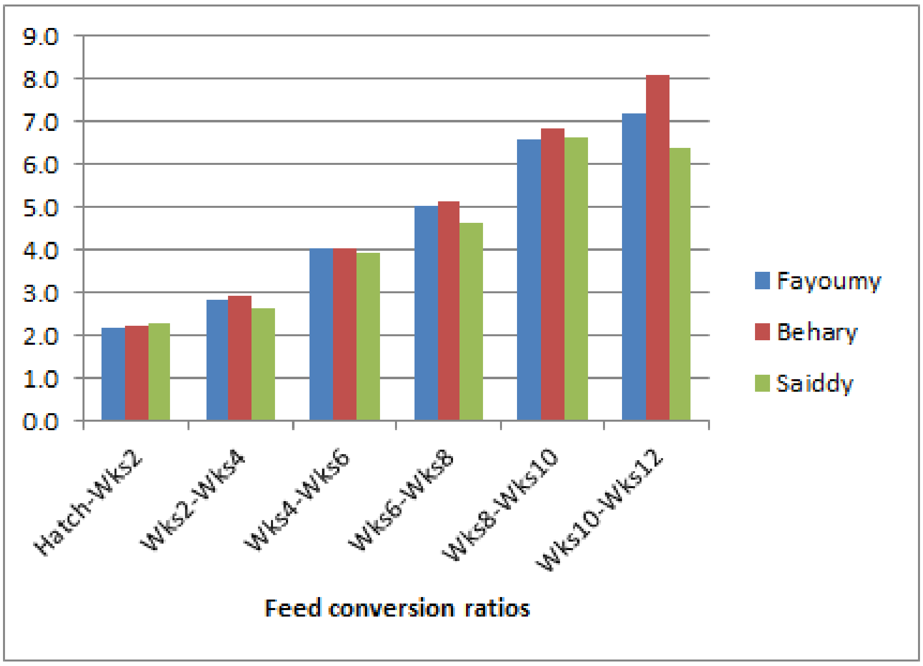


Figure (4): Mean feed conversion rations in Egyptian geese phenotypes from hatching to 12 weeks of age.

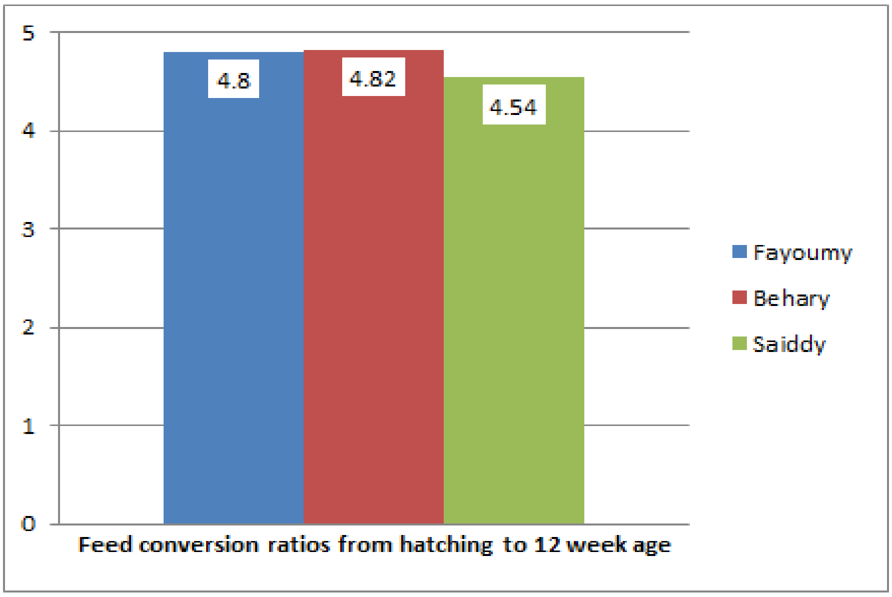


Figure (5): Mean mature body weights in Egyptian goose females of different phenotypes.

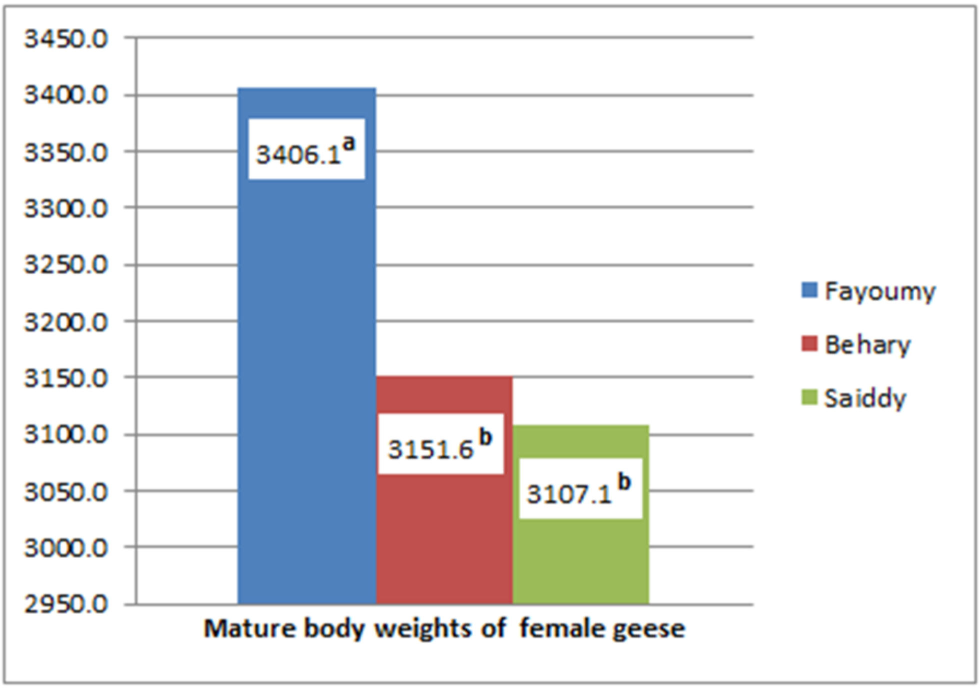
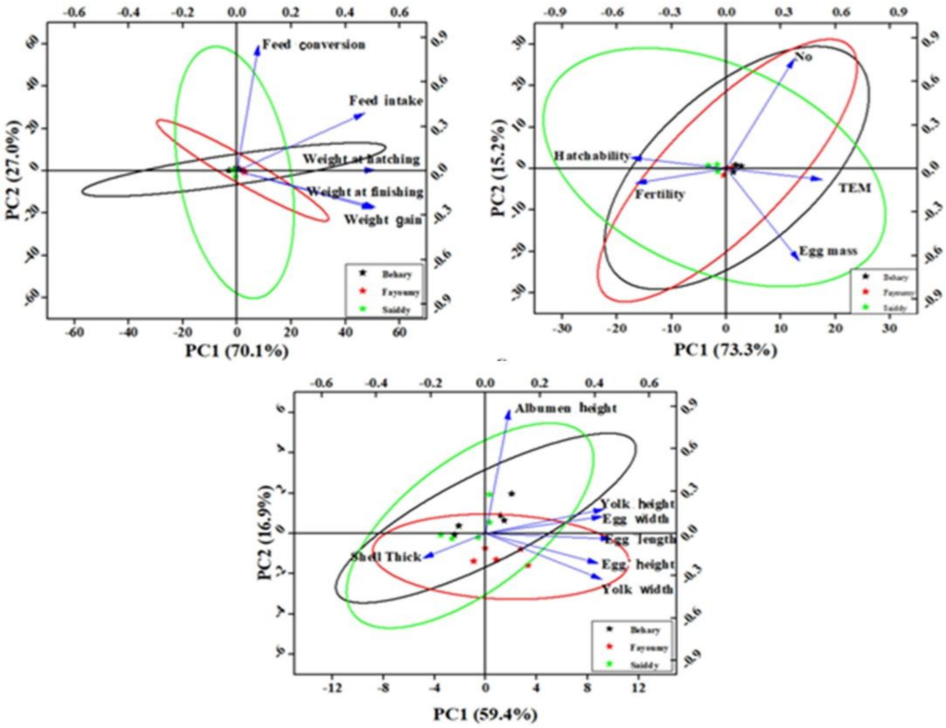


Figure (6): Plot of productive traits, reproductive traits, and egg quality assessments in the three Egyptian geese using principal component analysis (PCA) and cluster analysis.



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Productive traits; Reproductive traits; Egg quality; Phenotypes; Egyptian geese.

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الملخص العربى

توصيف الأداء الإنتاجي والتناسلي للطرز المظهرية في الأوز المصري (Anser anser)

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دراسة الخصائص المظهرية للأوز المصري نتج عنها وجود ثلاثة طرز مظهرية: الفيومي ، والصعيدي ، والبحري ، والتي تمت تربيتها في مناطق مصرالوسطى ، ومصرالعليا ، والدلتا على التوالي. الهدف من هذه الدراسة هو وصف خصائص الإنتاج والتكاثر للثلاثة طرز المصرية (Anser anser) من أجل إلقاء الضوء على الجوانب الاقتصادية لتحديد الأهداف الاستراتيجية للحفاظ على التنوع بها والاستخدام طويل المدى لها. أيضًا ، قد يكون توصيف ميزات الإنتاج و ميزات التناسل جزءًا للإجابة على سؤال حول احتمال أن يكون الأوز المصري عشيره واحدًا أو أكثر. تم إيواء كل طرز مظهري من الطيور بشكل منفصل. تم استخدام الطرز المظهرية من الفيومي ، والصعيدي ، والبحري لتقييم جودة البيض ، والخصوبة ، والفقس ، وأداء النمو. لا يوجد فرق معنوي (P 0.05<) بين الطرز المظهرية في استهلاك العلف اليومي وزيادة الوزن اليومي والتحويل الغذائي. كانت أعلى قيمة في أوزان الجسم عند الإناث البالغه في نمط الفيومي. صنف بحيري كان له أقل معدلات الخصوبة والفقس. الصفة للفيومي كانت لها أعلى القيم في وزن البيض ووزن الكتكوت عند الفقس. تميزت الدراسة الحالية بخصائص الإنتاج والتكاثر التي أظهرت اختلافًا طفيفًا بين الطرز المظهرية. قد نستنتج أن كلا من الفيومي والبحري لهما ميزة نسبية مرتفعه في الزيادة اليومية بالجسم. قد يكون الصعيدي له ميزة نسبية مرتفعه في معدلات الخصوبة والفقس. مطلوب مزيد من البحث حول خصائص الأداء في الأنماط المظهرية للأوز المصري لتقييم أدائها الاقتصادي.